O. R. ROGERS.

APPARATUS FOR RECORDING THE APPROXIMATE DURATION OF RAINFALL.

APPLICATION FILED DEC. 23, 1915.

1,236,381.

Patented Aug. 7, 1917.

4 SHEETS—SHEET 1.

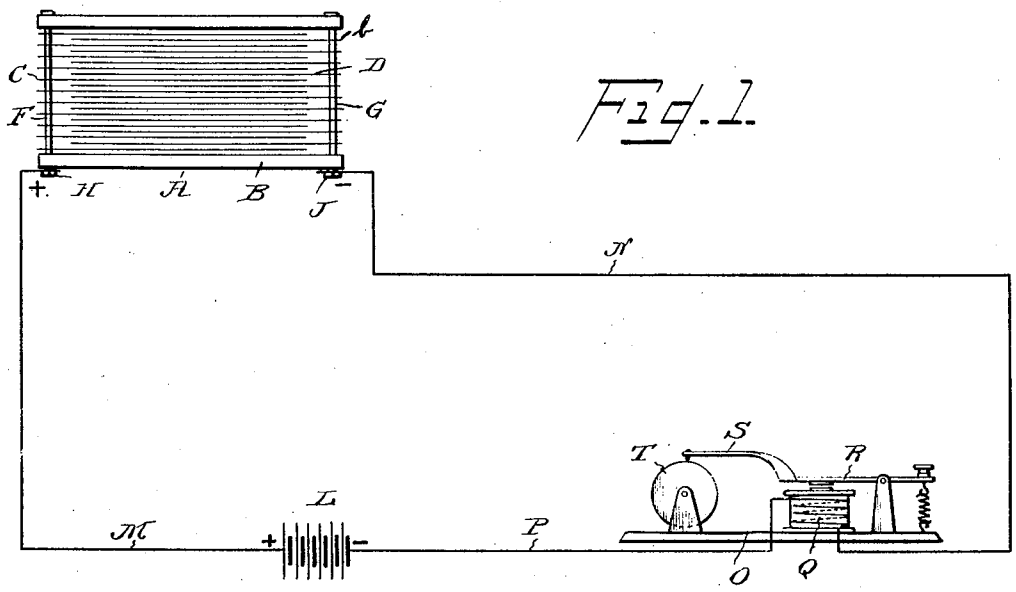


Fig. 1.

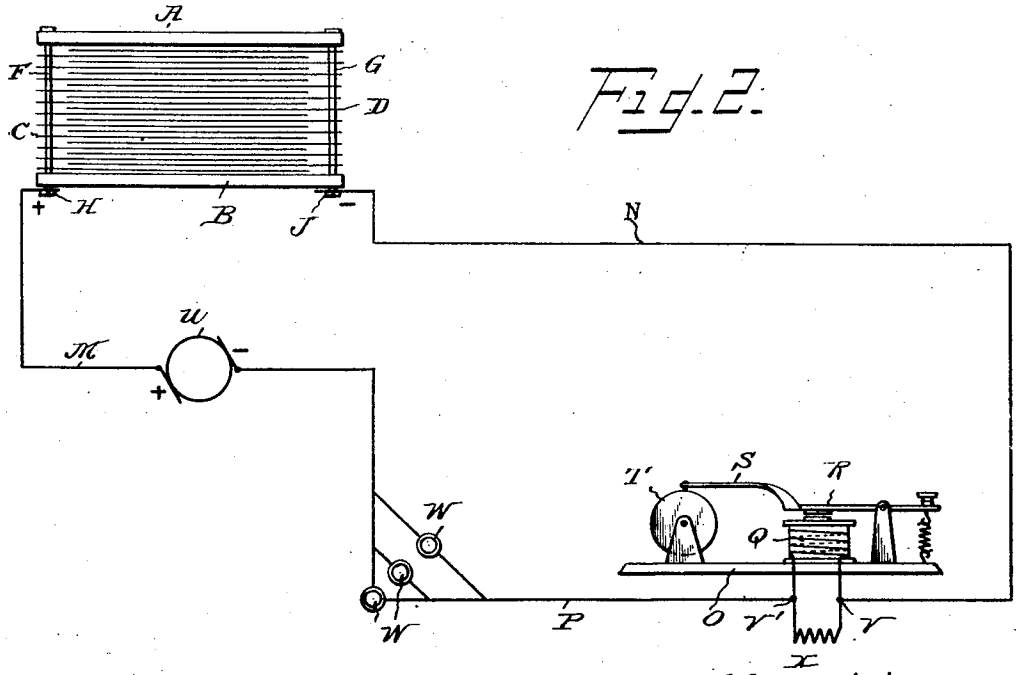


Fig. 2.

ATTEST.

Harry L. Amer.

Hermann E. Hobbs

Orlin R. Rogers INVENTOR.

By Charles W. Boyle

Attorney

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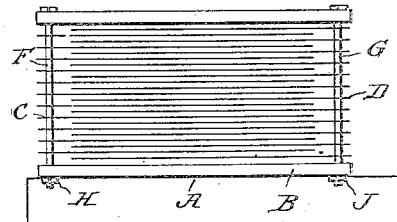


Fig. 3.

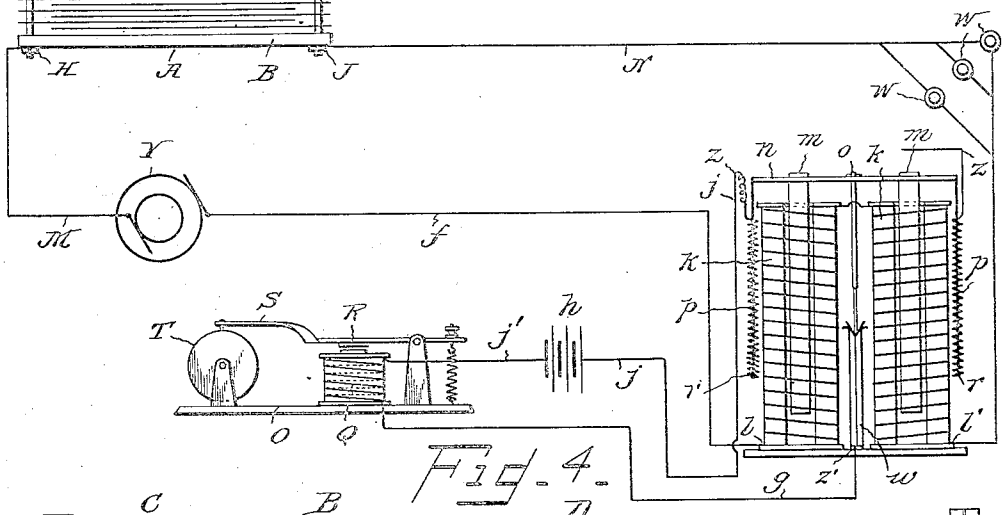


Fig. 4.

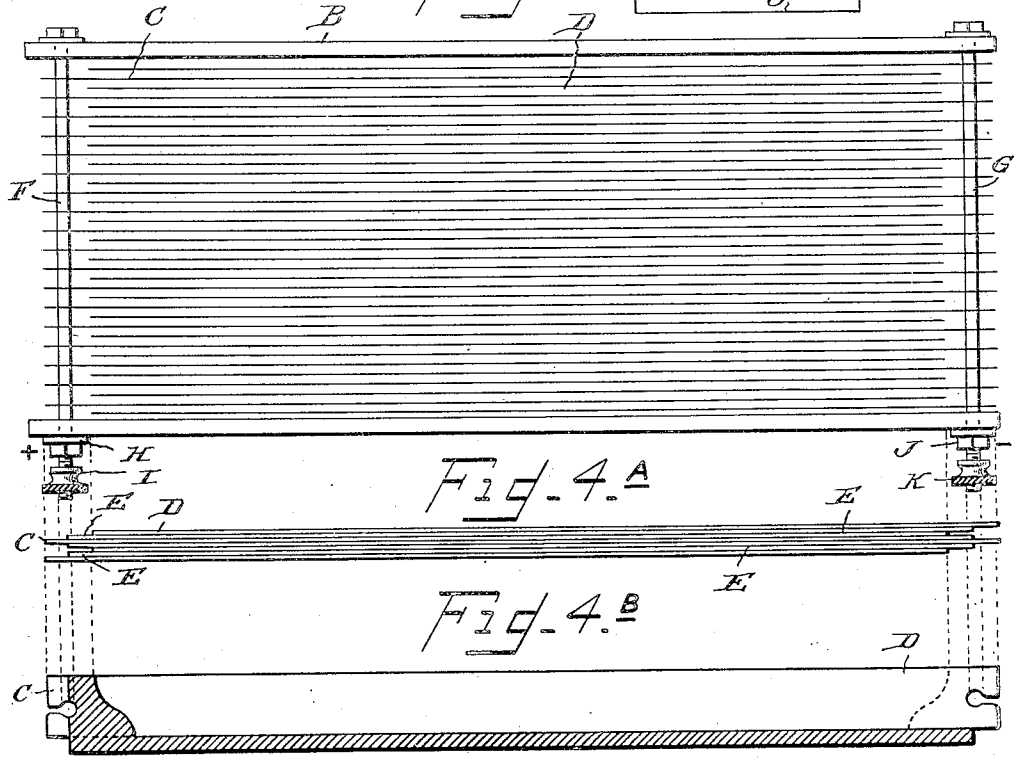


Fig. 4. A

Fig. 4. B

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Hermann E. Hobbs

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4 SHEETS—SHEET 3.

Fig. 5.

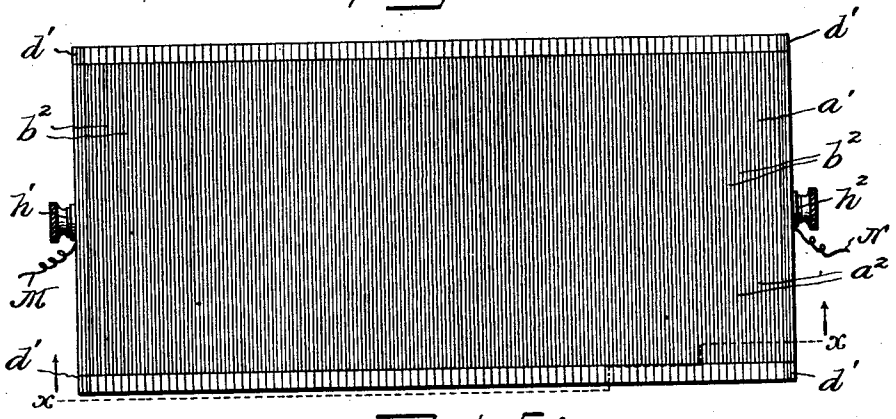


Fig. 5A.

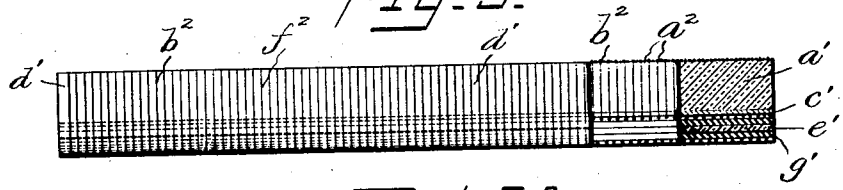


Fig. 5B.

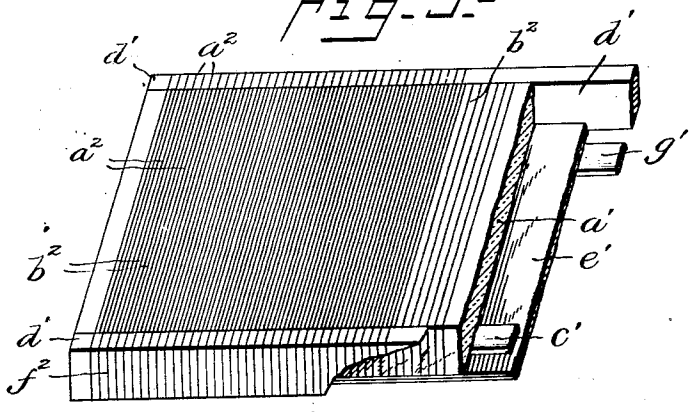
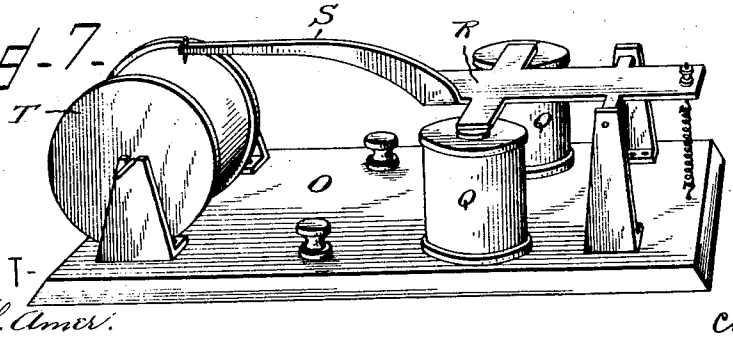


Fig. 7.



ATTEST-

Harry L. Amer.

Hermann E. Hobbs

Orlin R. Rogers

INVENTOR-

By

Charles W. Boyle

Attorney

O. R. ROGERS.

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4 SHEETS—SHEET 4.

Fig. 6c

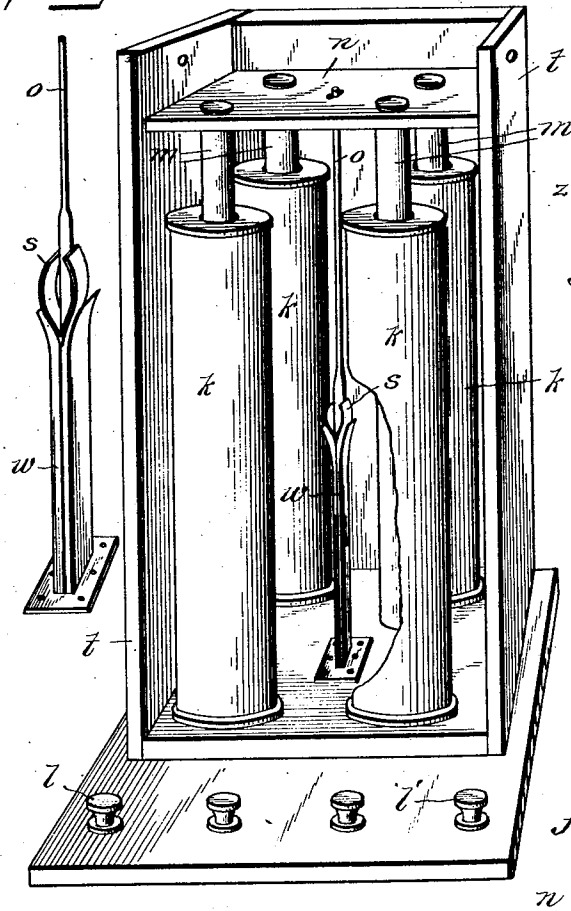


Fig. 6.

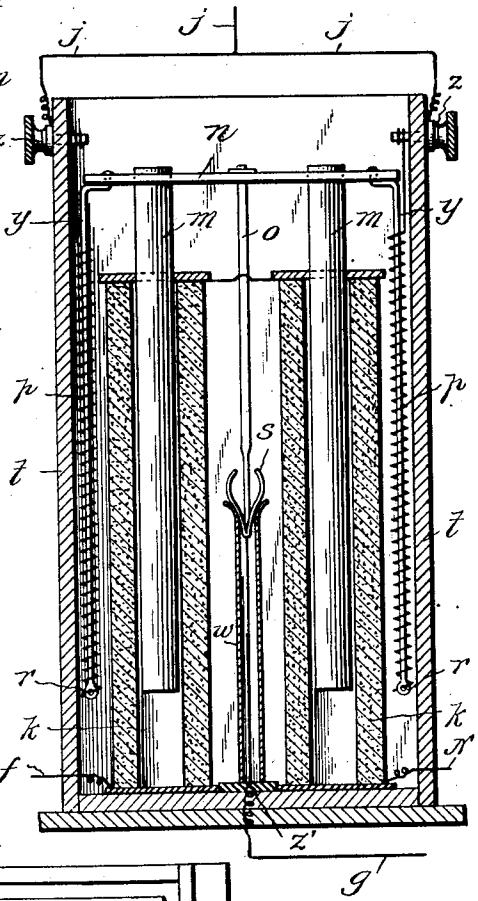


Fig. 6A

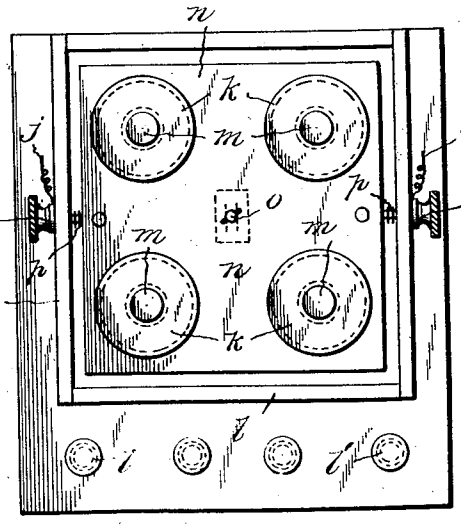


Fig. 6B

ATTEST.

Harry L. Elmer.

Hermann C. Hobbs

Orlin R. Rogers

INVENTOR.

By Charles W. Boyle

Attorney

UNITED STATES PATENT OFFICE.

ORLIN R. ROGERS, OF COLUMBIA, MISSOURI.

APPARATUS FOR RECORDING THE APPROXIMATE DURATION OF RAINFALL.

1,236,381. Specification of Letters Patent. Patented Aug. 7, 1917.

Substitute for application Serial No. 748,050, filed February 12, 1913. This application filed December 23, 1915. Serial No. 38,442.

(DEDICATED TO THE PUBLIC.)

To all whom it may concern:

Be it known that I, ORLIN R. ROGERS, a citizen of the United States of America, and an employee of the Department of Agriculture of the said United States, residing in the city of Columbia, State of Missouri, (whose post-office address is Columbia, Mo.,) have invented a new and useful Apparatus for Recording the Approximate Duration of Rainfall.

This application is made under the Act of March 3, 1883, chapter 143 (22 Stat. 625), and the invention herein described and claimed may be used by the Government of the United States, or any of its officers or employees, in the prosecution of work for the United States, or by any person in the United States, without the payment of any royalty thereon.

My invention relates to an apparatus for recording the approximate duration of rainfall.

The object of my invention is to provide a device that is simple in construction, easily adjusted for operation, and capable of recording the approximate duration of rainfalls. My invention hereinafter described consists of a specially constructed receiver, having sufficient surface to arrest some raindrops, even in scattering rains, and is interlaced with series of opposed terminals having a narrow space between the terminals. Insulation that is incombustible, impervious to moisture, and durable under constant exposure to the elements is arranged between said terminals. The receiver is suitably adjusted in an electric circuit comprising a battery and an electric magnet, or the same may be disposed in an electric circuit consisting of a direct dynamo, or an alternating current dynamo, and battery, and an electro-magnet. As the opposed series of terminals carried by the receiver have no contact with each other, due to the space between said terminals, current will not flow through the circuit, until a suitable conductor arcs the current from one opposed terminal to the other, and to accomplish this purpose the raindrops are used for arcing the current from one series of the opposed terminals to the other, so as to complete the circuit.

The nature, characteristic features, and scope of my invention will be more readily understood from the following description taken in connection with the accompanying drawings, forming a part hereof, wherein—

Figure 1 is a diagrammatic view of my apparatus adjusted for a battery current.

Fig. 2 is a diagrammatic view of my apparatus adjusted for operation by means of a direct current.

Fig. 3 is a diagrammatic view of the apparatus adjusted for operation by current from an alternating current dynamo.

Fig. 4 is a longitudinal sectional view of the receiver employed in my invention as shown in Figs. 1, 2 and 3.

Fig. 4A is a top view enlarged; Fig. 4B is a vertical longitudinal sectional view; Fig. 5 is a top view of another form of receiver which may be so employed; Fig. 5A is an elevation partly in section on line *xx* of Fig. 5; Fig. 5B is an enlarged detail perspective of a portion of Fig. 5; Fig. 6 is a detail perspective view of the set of solenoid coils employed in my invention, as shown in Fig. 3, and Fig. 6A is a vertical longitudinal section of Fig. 6; Fig. 6B is a top plan view of Fig. 6; Fig. 6C is a detail perspective of plunger and contact springs of Fig. 6; and Fig. 7 is a detail perspective view of the recording magnet.

Referring to the drawings, A, represents the receiver, which consists of a framework, B, made of concrete, metal, or other suitable material, carrying a series of thin plates, C C, constructed of tin, German silver, or other non-oxidizing metal. Each element of the series of plates, C C, project at one end of the receiver beyond the insulating material hereinafter described, as shown at *b b*. D D designate another series of thin plates, made either of tin, German silver, or other adaptable non-oxidizing metal, each element of which series projects at the same end of the receiver, A, said end being opposite to the end from which the series of plates, C C, project. Thin sheets, E E, of mica, or other suitable heat-resistant insulating material,

incombustible and impervious to moisture, and durable under constant exposure to the elements, are placed between each element of the series of plates, C C, and D D. These sheets of mica possess sufficient thickness effectually to insulate each element of the aforementioned series of plates from the other elements on either side of the said respective series of plates. A strip of copper, F, or other proper conductor of electricity, is placed at right angles to the plates, C C, and arranged under the projecting ends of the elements of said plates, and secured thereto by soldering or other satisfactory means. Another strip of copper, G, or other proper conductor of electricity, is placed at right angles to the respective elements of the series of plates, D D, opposite to the end of the receiver, A, where the copper strip, F, is adjusted. The copper strip, G, is likewise arranged under the projections of each element of the plates, D D, and securely attached thereto by soldering or in any other suitable way. A binding post, H, is adjusted to one end of the frame, B, having a screw thread and nut, I, fitted thereon, so that connection with the positive wire of any electric circuit may be made therewith. At the other end of the frame, B, is adjusted a second binding post, J, likewise having a screw and a nut, K, fitted thereon, so that connection with the negative wire of any electric circuit may be made. Connection between the post, H, and the post, J, in a complete circuit is made in manner as hereinafter shown.

L, indicates the place where the battery is placed, and M the circuit wire running from the battery to the post, H. N represents the circuit wire running from the post J, in Fig. 1, to the recording magnet, O, and P designates the circuit wire between the battery at L, and the recording magnet, O. The recording magnet comprises magnet coils, Q Q, magnet armature, R, with an extended arm, S, engaging when depressed a revolving drum, T, on which is recorded the approximate duration of the current flow.

In operation, the receiver, A, is placed in a suitable location, exposed to the rainfall and connected with a battery by the circuit wire, M, and with a recording magnet, by the circuit wire N, while the battery is connected with the recording magnet, O, by circuit wire, P. The battery is accordingly adjusted for sending current through the circuit. A drop of water falling anywhere on the surface of the receiver, A, where the plates or positive terminals, C C, and the plates or negative terminals, D D, are adjusted, will bridge the insulation sheets, E E, arranged between the series of plates, C C and D D, thereby causing the current to arc through the rain-drop from the positive terminals, C C, to the negative terminals, D D, copper strip, G, thence to the negative binding post, J, and transmitted therefrom over the circuit wire, N, to the magnet coils, Q Q, thence through the circuit wire, P, to the battery at L, thence through the circuit wire, M, to the binding post, H, and through the copper strip, F, to the plates, C C. The passage of the current through the raindrops evolves heat in proportion to its resistance, and the heat evolved rapidly reduces the water to a vapor state, so that unless other raindrops continue to fall, the current ceases to flow through the circuit, due to there being no connection between the plates, C C and D D, and the insulation strips, E E, without water or some other conducting matter bridging the space between the said series of opposed terminals. During the time current passes through the circuit as described, the armature, R, of the electric magnet, O, is drawn down against the magnet poles, thus causing the arm, S, to record on the drum, T, the duration of the current flow, from which record can be readily computed the approximate period of rainfall.

In Fig. 2, I have illustrated the apparatus in another form for operation with direct current dynamos. In this view, U represents the location of the direct current dynamo, and M the circuit wire transmitting electric current therefrom to the post, H, of the receiver, A. N is a circuit wire running from the post, J, of the receiver, A, to the recording magnet, O, and P, the circuit wire running from the recording magnet to the direct dynamo, U, being intercepted in its course by a plurality of incandescent resistance lamps, W W, either in series or in parallel, for regulating the voltage to the desired amount. V V′ represent terminal posts of the recording magnet coils, Q Q, and also of the adjustable resistance coil, X, by means of which resistance the amount of current shunted through the recording magnet coils, Q Q, may be regulated.

In practice, the receiver, A, is placed in a position exposed to the rain, as hereinbefore described, and connected with the direct current dynamo, U, by the circuit wire, M, and with the recording magnet, O, and the adjustable resistance, X, by the circuit wire, N, at the terminal post, V. The recording magnet and the adjustable resistance are connected at V′ with the dynamo, U, by the circuit wire, P. The current flows through the circuit wire, M, to the binding post, H, through the copper strip, F, and into the elements of the series of plates, C C, of the receiver, A, which forms contact with the raindrops. The current arcs through the raindrop across the insulation strips, E E, into the elements of the series, D D, through the copper strip, G, and the binding post, J, into the circuit wire, N, thence to the terminal post, V, of the recording magnet, O. At

V, the current divides, part passing through the magnet coils, Q Q, and part through the resistance, X, uniting at V', and returning to the dynamo, U, through the circuit wire, P, and the resistance lamps, W W. As the current arcs through the raindrop, the current instantly flows through the circuit wire, N, the magnet coils, Q Q, the circuit wire, P, to the dynamo, U. This current flow energizes the magnet poles, the armature, R, is drawn down, and the arm, S, attached thereto, engages the paper arranged on the drum, T, and the recording of the current flow begins.

Where current is obtained from an alternating current dynamo, the series of solenoid coils illustrated in Figs. 3 and 6 should be employed, in order to eliminate vibration of the recording magnet armature. Each cycle or alternating impulse of the current successively attracts and releases the magnet armature and these cycles are of such frequency as to produce an objectionable vibration of the magnet armature and its attached arm. The solenoid coils shown in Figs. 3 and 6 consist of copper wire coils, *k k k k*, connected either in series or in parallel. *l l'* designate binding posts or terminals of the windings of the coils, *k k k k*. To these terminals are connected circuit wires, N, and *f*, of the alternating circuit shown in Fig. 3. *m m m m* represent the cores of the coils, *k k k k*, and are made of fine wires held together by cement into slender cylinders, which loosely fill the hollow coils of the solenoid bobbins. A plate of iron, *n*, serves as a yoke for the cores, *m m m m*, rigidly fastened thereto. The yoke, *n*, securely holds the said cores in proper positions with respect to their respective coils, *k k k k*, and furthermore rigidly holds the plunger, *o*, at right angles with itself. The plate, N, with its cores, *m m m m*, and plunger, *o*, has free vertical motion, and is supported in such free state of motion by two long spiral springs, *p p*. To the plate, *n*, are secured two slender rods, *v v*, extending at right angles to said plate, and having at their lower ends eyelets, *r r*, in which one end of the spiral springs, *p p*, is fastened. The spiral springs, *p p*, circumscribe the rods, *v v*, throughout their length, and have their upper ends fastened to the inclosing box, *t*, so as to provide means for affording free vertical motion of the plate, *n*, and cores *m m m m*. Two strips, *s s*, constructed preferably of brass, are secured to the lower end of the plunger, *o*, and extend laterally therefrom in such a manner as to make contact with metal springs, *w w*, whenever the plate, *n*, with its attached cores and plunger are caused to move downwardly. The thin springs, *w w*, extend upward from the base of the mechanism, the upward extremities being curved outward and arranged opposite each other in a way by which contact with the strips, *s s*, is formed whenever said springs are slightly depressed. *z* and *z'*, designate the terminals where the circuit wires, *j* and *g*, of Fig. 3, are connected.

The operation of my apparatus as illustrated in Fig. 3 may be briefly summarized as follows:

Receiver, A, regulates the current flow in circuit wires, M and N, to the actual time rain begins to fall. The current flow, as regulated by the receiver, energizes the solenoid coils, *k k k k*, producing a movement of the cores, *m m m m*, downward so long as current is flowing through said receiver. This downward pull upon the cores, *m m m m*, causes a corresponding downward movement of the plunger, *o*, which, in turn, produces a contact of the springs, *s s*, and *w w*. As a result the circuit wires, M and N, induce a movement within the solenoid unit which produces a synchronous current flow in circuit wires, *g* and *j*. The duration of the current flow in the two separate circuits, M and N, *g* and *j*, are identical, and such duration depends upon the period of rainfall in order that the raindrops will bridge the space between the plates, C C and D D, and the insulation strips, E E, and act as a conductor for the current. Upon cessation of the rain, the flow of current is broken. The current flows from the alternating current dynamo at Y, through the circuit wire, *f*, to the binding post, *l*, and through the coils, *k k k k*, thence through the binding post, *l'*, circuit wire, N, resistance lamps, W, W, to the binding post, J, thence through said binding post, J, strip of copper, G, into the series of plates, D D, of the receiver, A, that form contact with the raindrops. At this point the current arcs through the raindrops, across the strips of mica, E E, to the plates C C, where it is conducted through the copper strip, F, to the binding post, H, thence over the circuit wire, M, to the alternating current dynamo at Y. While the circuit is thus complete, the cores, *m m m m*, of the coils, *k k k k*, are drawn downward, and the plunger, *o*, with its attached springs, *s s*, is also drawn downward, and come in contact with the stationary springs, *w w*, which contact completes the battery circuit. Current thereupon flows from the battery at *h*, through the circuit wire, *j*, binding post, *z*, spiral springs, *p p*, plunger, *o*, contact springs, *w w* thence through the binding post, *z'*, circuit wire, *g*, magnet coils Q Q, and thence to the battery through circuit wire, *j'*. The armature of the magnet recorder is drawn down simultaneously upon the contact of the plunger, *o*, with the springs, *w w*, and the arm, S, engaging a strip of paper suitably placed on the drum, T, records the duration of the current flow.

When the circuit is in operation during

rainfall, heat is instantly evolved within the raindrops, and within the elements of the opposed series of plates, C C and D D, where contact with raindrops is formed. This heat transforms the raindrops into vapor, so that when the rain stops, the cessation of the current flow is immediately obtained. The cessation of the current flow deënergizes the coils, *k k k k*, and the magnetic tension of the fine wire cores, *m m m m*, is instantly lost, thereby causing the spiral springs, *p p*, to draw the plate, *n*, with its attached cores, *m m m m*, and plunger, *o*, to their original position, thus breaking the contact between the springs, *s s* and *w w*.

In Fig. 5, I have illustrated another form of receiver, which may be used in my invention instead of the receiver shown in Fig. 4. Referring to the receiver disclosed in Fig. 5, a' represents a plate constructed either of glass, porcelain, or other suitable material having in its upper face parallel grooves, a^2 a^2. Into these grooves is fitted a continuous winding wire, b^2, made of tin, copper, German silver, or other adaptable non-oxidizing material. This winding wire passes around and around the plate, a', fitting into each alternate groove in the upper face thereof. A copper strip, c', is adjusted between the lower face of the plate, a', and the winding wire, b^2. Each winding of the wire, b^2, passes over the copper strip, c', at right angles, and at the point of intersection is soldered to said strip. Two strips, d' d', made of hard rubber, glass, or other suitable insulating material, are placed on opposite sides of said plate, a', at right angles to the wire winding, b^2, and a thin strip, e', constructed of fiber, mica, or other proper insulating material, is adjusted to the under side of the plate, a', beneath the wire winding, b^2, and also beneath the copper strip, c'. Another continuous winding of tinned copper, f^2, passes around the plate, a', strips, d' d', and the strip, e', and fits into the alternate parallel grooves of the upper face of said plate, which do not receive the winding, b^2. The winding, f^2, may be made of German silver, or other suitable non-oxidizing material. Between the lower face of the strip, e', and the wire winding, f^2, stretched across the lower face of said strip, e', is placed a copper strip, g'. Each wire of the winding, f^2, passes over the strip, g', at right angles and at the point of intersection is soldered thereto. h' and h^2 represent binding posts for affording means of connection with the circuit wire, M, and the circuit wire, N. Adjustment of the receiver to said wires is made in the same manner as shown in Figs. 1, 2, and 3, of the drawings. This receiver performs the same function in the same way as receiver, A, hereinbefore described.

From the foregoing it is thought that the construction, operation, and many advantages of the herein-described invention will be apparent to those skilled in the art, without further description, and it will be understood that various changes in the size, shape, proportion, and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Having thus described my invention, I claim:

An apparatus comprising a receiver, a separate longitudinal series of non-oxidizing plates, one series having projecting portions at one end, and the other series having projecting portions at the other end, copper strips and binding posts, resistant insulating sheets adjusted between each of said series of plates, means for connecting said receiver with a battery and with a recording magnet, and means for connecting said magnet with said battery for completing an electric circuit for recording the duration of rainfall.

In witness whereof, I affix my signature in the presence of two subscribed witnesses.

ORLIN R. ROGERS.

Witnesses:
GEORGE REEDER,
JOSEPH W. HEISLER.